

THE IMPACT OF POLLUTION PREVENTION PRACTICES ON COMPETITIVE OUTCOMES OF MANUFACTURING COMPANY

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Abstract- *This study investigates the effect of pollution prevention practices in the important and vast industry of knit wear sector in Bangladesh. This study presents the relationships between some specific sustainable pollution prevention practices and their relative specific competitive outcomes. General proposition about the competitive advantages (cost, quality, etc.) were developed from the benefits of pollution prevention practices. Data were collected through a questionnaire based survey. Relative importance index (RII) was used in the survey to measure the impact of practices on the outcomes. Results of the study indicate that pollution prevention practices help to decrease manufacturing cost and enhance company reputation significantly. These specific findings might be helpful to motivate the organizations to implement green initiatives.*

Keywords: Green manufacturing, Competitive advantage, Knitwear, Pollution prevention

1. INTRODUCTION

It is widely recognized that industrialization has given high standards of living. But this has not come without cost. The consumption of resources such as raw materials and energy necessary to produce the products we take for granted is enormous. It is estimated that 10 tons of materials are necessary per person per year to support the standard of living of USA. 94% becomes waste within a few months after extraction. In the United States, it is estimated that four pounds of waste is generated daily by each person. In the United States, 80% of waste is landfilled, 9% incinerated and 11% recycled [1]. Current estimates indicate that the costs due to waste disposal are greater than \$100/ton. These problem arose due to not considering environmental issues in manufacturing. However, in the last decade or so, Environmentally Conscious Manufacturing has become an obligation to the environment and to the society itself, enforced primarily by stakeholders including regulators, customers, shareholders, board members requirement to be more environmentally responsible to their products or processes [2], [3] and [4]. The reasons for these stakeholder demands include regulatory requirements, product stewardship, enhanced public image, potential to expand customer base, and potential competitive advantages (e.g., [3], [4] and [5]).

Every product that is manufactured has its impact on the environment in its life-cycle. Garments products are no exception from it. Garment industries and their products can also adopt environmental manufacturing practices. These practices will not only face the environmental issues but can also provide the organization with competitive advantages.

This research focus on apparel industry as it is one of vast and wide industry all over the world and apparel industry has notable number of environmental impacts that occur at different stages of the apparel life cycle (such as yarn manufacturing, knitting, dying, RMG). The value addition to apparel business from the knitwear sector is about 75% and contribution in GDP is about 6.92% in FY 2015-16 [6]. Due to rapid expansion of the knit sector, poverty rate of Bangladesh was reduced significantly. Knitwear industry is one of the dominating export oriented area in Bangladesh and it backs Bangladesh number two position in the world in terms of knitwear export. BKMEA has already set the target to export at least 20 billion USD worth of knit products by 2020 and generate employment over 2.8 million [6]. Apart of the export amount there is also a big domestic market of hosiery and knitwear in Bangladesh. The knit wear industry has had a long history of environmental challenges, including substantial use of resources (like energy, water), disposal of manufacturing waste, and disposal of used products. In addition, most of the industry is located within 30 kilometers of Dhaka, Bangladesh; therefore, production and disposal practices affect a large regional population.

While there is a relatively abundant literature on drivers of environmental practices [7], [8], as well as conceptual and case study research on the relationships between environmental practices and performance measures [3], [4], the empirical research on environmental manufacturing practices and competitive outcomes is more limited, as well as inconclusive. Over time, researchers have assigned various labels to various types of environmental practices. Among the

more often cited labels used to differentiate approaches to environmental practices are pollution control and pollution prevention [3], [7]. Pollution control is an “end of pipe” approach and typically refers to the methods to trap, store, treat, and/or dispose of pollution after it is created. Pollution control is viewed as costly and nonproductive since it represents an expense that yields no potential for competitive advantage. It is associated with minimum level compliance, rather than pursuit of competitive advantage through environmental practices. Therefore, this study will focus on pollution prevention.

Pollution prevention reduces or prevents pollution and can result in lower costs [3]. Examples of pollution prevention include reducing the usage of resources, reducing the amount of waste generated, and recycling. According to Porter and vander Linde [4], pollution represents waste and loss of resource productivity. Therefore, product and process innovations to reduce or prevent pollution can improve resource productivity and competitiveness. Hence, the question that this study will try to answer can be rephrased as: What is the relationship between specific pollution prevention practices and specific competitive outcomes?

This study will explore the existing pollution prevention practices that are used more or less often in knitwear industry of Bangladesh. In this study industry specific sustainable pollution prevention practices (e.g., recycling waste etc.) and their relationship or lack thereof with specific competitive manufacturing outcomes (e.g., cost and quality etc.) will be examined. Specific competitive preemption outcomes of company image, innovativeness will also be investigated in the context of environmentally sustainable manufacturing practices.

2. METHODOLOGY

This section describes an exploratory study that attempts to test the hypothesis of pollution prevention practices will tend to decrease manufacturing cost and improve product quality and also address some of the methodological limits that were cited with respect to earlier empirical studies on environmental manufacturing practices and competitive outcomes.

As research on industries such as chemicals, oil refining, and wood/paper pulp is already well established, this work will focus on a less-researched industry. Correspondingly, since some environmental practices tend to be industry specific [9], this work will focus on knitwear manufacturing industry. Knitwear manufacturing is an important industry to study for several reasons. Knitwear manufacturing has had a long history of heavy resource usage and environmental challenges. Knitwear manufacturers are heavy users of water and energy, and must track and report air and water emissions. In addition, most of the industry is located in or around Dhaka, therefore, the industry's production processes affect a large regional population. There is little empirical research on environmental practices in the Bangladesh knitwear industry.

This research work adopted the theoretical viewpoints of researchers including Hart [3] and Porter and van der Linde [4]. A preliminary list of measures of pollution prevention practices [3], were collected and adapted to

knitwear industry. Since some manufacturing practices can be industry specific [9], as the list was developed, a search for measures of environmentally sustainable practices were also be conducted through the web sites of knitwear manufacturers and industry publications. Finally 7 practices were included in a list as pollution prevention practices. After identifying the pollution prevention practices the competitive outcomes related to them were identified. General proposition about the competitive advantages were developed from the benefits of pollution prevention practices that are shown below:

Proposition 1: Pollution prevention practices will tend to decrease manufacturing cost.

Proposition 2: Pollution prevention practices will tend to increase productivity.

Proposition 3: Pollution prevention practices will tend to improve employee morale and participation.

Proposition 4: Pollution prevention practices will tend to enhance company reputation.

In this study primary data were used to test the aforementioned propositions. Data were collected through field Survey using questionnaire from the manager designated as best qualified to respond with respect to the environmental practices adopted by the company. The survey was designed such a way that the respondents will be presented with a list of pollution prevention practices (e.g., reducing energy usage, reducing raw materials usage, reducing emissions, recycling water etc.) and a list of competitive outcomes (e.g. decreases manufacturing cost, increases product quality, improves company image etc.). They will be instructed to give weightage in 1 to 5 Likert's scale, where 1 indicates no impact to 5 for major impact. Relative importance index (RII) was used in the survey to measure the impact of practices on the outcomes. RII is calculated using the following equation:

$$RII = \frac{\sum W}{N \times A}$$

Where W = weighted given by a respondent, N = total number of responses, A = highest weight. Finally, responses were collected through survey and the number of respondent factories were 46.

3. ANALYSIS AND RESULTS

Response percentages of pollution prevention practices and outcomes are aggregated and averaged to find out the relative importance of each practice toward the competitive outcomes. Finally, for an individual outcome, the RII score of each practice averaged and checked whether they support the propositions or not.

As indicated in table: 1; pollution prevention practices tend to be used by most respondents in the Bangladesh knit industries. There are 7 pollution prevention practices that include all the outcomes. Pollution prevention practices like reducing raw material usage have got maximum of 0.99 RII score in an outcome that is a major impact. From table-2, it is seen that five out of seven pollution prevention practices have major impact on the reducing manufacturing cost and rest two practices like reducing emission and divert solid waste from landfill have negligible or no impact on this measure. Average responded RII score of 0.73 for reduce manufacturing

cost indicates that pollution prevention practices help to decrease manufacturing cost significantly. So, the proposition 1 is strongly supported with respect to knitwear industry.

Productivity is something that doesn't only related to the quantity of production per unit time. Other factors related to company image and cultures are also related to productivity. As shown in table-2, the reported usage of pollution prevention practices classified has no relation to the productivity such as, reducing emission, reducing

chemical usage and divert solid waste from landfill. Only two of them got major impact, one of them got marginal impact and one of them got negligible impact. So, on an average the pollution prevention practices have got RII score of 0.52 on the outcome of increase productivity, indicated as marginal impact and thus proposition 2 is not supported.

Table 1: Pollution Prevention Practices Response Percentage

Pollution prevention practices	Competitive outcomes (%)								
	Practices responses percentage (n=46)	Reduces manufacturing cost	Increases productivity	Improves employee morale and participation	Enhances company reputation	Reduces liability	Increases quality	Attracts new customer	Promotes innovative ideas
Reducing raw material usage	100.00	100.0	86.96	08.70	65.22	65.22	8.69	21.74	69.57
Reducing emissions	74.00	41.17	00.00	29.41	100.0	100.0	05.89	58.82	70.59
Reducing solid waste	87.00	100.0	90.00	20.00	95.00	95.00	20.00	10.00	45.00
Reducing chemical usage	100.00	82.61	17.40	13.04	91.30	100.0	04.34	08.70	47.83
Recycle and reuse defectives	100.00	86.96	56.52	17.39	78.26	100.0	65.22	47.83	78.26
Reduce energy use	87.00	95.00	35.00	15.00	80.00	65.00	00.00	35.00	95.00
Divert solid waste from landfill	91.00	00.00	00.00	14.29	61.90	95.24	09.53	38.09	100.0

Table 2: RII Score of Pollution Prevention Practices

Pollution prevention practices	Competitive outcomes (RII Score)							
	Reduces manufacturing cost	Increases productivity	Improves employee morale and participation	Enhances company reputation	Reduces liability	Increases quality	Attracts new customer	Promotes innovative ideas
Reducing raw material usage	0.99	0.97	0.23	0.69	0.68	0.26	0.36	0.66
Reducing emissions	0.48	0.24	0.41	0.96	0.96	0.22	0.58	0.75
Reducing solid waste	0.90	0.87	0.27	0.84	0.82	0.30	0.27	0.56
Reducing chemical usage	0.80	0.26	0.24	0.81	0.84	0.21	0.23	0.52
Recycle and reuse defectives	0.83	0.63	0.33	0.72	0.90	0.73	0.57	0.76
Reduce energy use	0.91	0.46	0.26	0.86	0.71	0.21	0.41	0.95
Divert solid waste from landfill	0.22	0.21	0.28	0.73	0.92	0.24	0.40	0.92
Cumulative RII Score	5.13	3.64	2.02	5.61	5.83	2.17	2.82	5.12
Average RII Score	0.73	0.52	0.29	0.80	0.83	0.31	0.40	0.73

Employee morale and participation could be a competitive outcome from pollution prevention practices

mentioned in previous studies. The reported usage of these practices like, reducing raw material usage,

reducing solid waste, reducing chemical usage and divert solid waste from landfill all four of them have no impact on employee morale and participation from the assessment of RII score. Although two of them got negligible impact on this measure and on an average this outcome has got the RII score of 0.29 as no impact. So, proposition 3 is not supported by the sustainable manufacturing practices as classified in pollution prevention practices.

The pollution prevention practices help to increase company reputation from lower to a higher extent. In pollution prevention practices six of them showing that there is a major impact on company reputation and one of them has moderate impact on this regard. The average RII score of 0.80 indicates that pollution prevention practices have major impact on enhancing company reputation as shown in table 2. Hence proposition 4 is strongly supported.

3.1 Ranking the Practices

RII values of the outcomes under each practice can also be used to rank the practices based on the impact. For this reason, average RII of each practice were calculated and the maximum valued RII practice was ranked first as it indicates that this practice has most impact on the competitive outcomes. Similarly rest of the practices were ranked serially based on the average RII value and this ranking of practices is given in table 3.

Table 3: Ranking of the practices

Pollution Prevention Practice	Average RII	Rank
Recycle and reuse defectives	0.6838	01
Reducing raw material usage	0.6050	02
Reducing solid waste	0.6038	03
Reduce energy use	0.5963	04
Reducing emissions	0.5750	05
Divert solid waste from landfill	0.4900	06
Reducing chemical usage	0.4888	07

4. DISCUSSION

The purpose of the study was to find out the existing environmental manufacturing practices that are currently available in knit industries and assess their potentialities towards competitive outcomes.

With few exceptions, pollution prevention practices seem to be consistently and robustly associated to decrease manufacturing cost and enhance company reputation. From the study it was found that, though divert solid waste from landfill practice was unanimously rejected as a source of cost reduction other practices support the outcome. As in knit industries, the solid wastes produced from operations go through several processes to be reused as a raw material so it has significant impact on cost reduction. Hence, these findings support Proposition 1 and are consistent with Hart [3], who argues that the main competitive advantage yielded by pollution prevention practices is cost. Likewise, these findings are consistent with Porter and Van der Linde [4], who argue that eliminating waste

through practices like resource reduction and recycling can decrease costs. Enhancing company reputation is an outcome indicated as profoundly impacted from respondent's point of view. Reducing chemical usage and reduction of emission have greater impact over company reputation where reduction of raw material usage and divert solid waste from landfill have a moderate impact over this outcome. Herein the proposition 4 is robustly supported by the claim that, pollution prevention practices have significant impact on company reputation.

Other outcomes associated to proposition 2 and 3 are virtually ineffective by pollution prevention practices. With consistent to previous finding of Porter and Van der Linde³ the proposition 2 propose that productivity increases by the pollution prevention practices but, this empirical research shows that productivity doesn't increase significantly. The reasons are the practices include reducing emission, divert solid waste from landfill that clearly have no relation with productivity though reducing solid waste and reducing raw material usage have significant impact on proposition 2. Likewise, in proposition 3 described as employee morale and participation is increased by pollution prevention practices but in actual practice employee morale couldn't be increased by the practices included in pollution prevention practices because all the practices are generally related to manufacturing processes that don't have impact on the employee morale.

5. CONCLUSION

This study was conducted in the field of knitting industry of Bangladesh and its result has shown the positive relation between pollution prevention practices and competitive outcomes. Although there is a common myth that, practicing sustainability requires additional cost, but this study shows that company reputation, cost and other specific preemption outcomes are positively related to sustainability practices and they can provide competitive advantages.

The result of the study easily points out those environmental manufacturing practices that can give significant advantages to a company and competitive preemption. Moreover, result of this study rigorously supports the previous researches and also provide links to new outcomes that are adopted for knitting sector. In addition, this study was designed to avoid methodological limitations of previous studies that drew results from different industries that differs practices, by focusing only one industry. So the result of the study are very much conclusive in this perspective and such research is also important in the context of Bangladesh because its industrial sector is growing rapidly. This study is believed to shed light on the advantages of using environmental manufacturing practices.

At the firm level this study can also have great impact. Its result can encourage manufacturers to implement environment friendly manufacturing and harvest their advantages. This will not only give them a competitive edge on the market but can also improve their reputation as a green company which is very much valued now a day by customers, investors and

stakeholders. Since some of the practices are very generic so its result can be used by other industry as well.

At the national or country level the environment of Bangladesh is continuously threatened by the unplanned industrial development. In regard of conserving and protecting the environment many schemes are taken by many organizations and manufacturing industries can also easily help in such schemes by embracing environment friendly manufacturing practices that does not only contribute towards the protecting environment but also gives competitive base to a company in the market.

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